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ABSTRACT

The effectiveness of notes provided students in two formats was studied. Students received either a completed set of notes or a partially completed set, with approximately half the information left blank. The study was also designed to investigate the effect of test taking conditions, whether immediate (shortly after the study session) or delayed by a week. Sixty-seven graduate students participated in this study, with 34 given the complete notes and 33 given the partial notes. Thirty-four students were in the immediate testing situation, and 33 took the test a week after the study session. The study text and the notes were presented online. Results indicate that partial notes were more effective than completed notes, especially for the application of the concepts to novel situations. There did not seem to be an effect for note format on learning factual information. It was evident that immediate testing is advantageous for the student, but findings show that when students study and construct the partial notes, they seem to recall the information better on the delayed test than do students in the completed notes condition. (Contains 50 references.) (SLD)

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Running Head: PARTIAL NOTES

CONSTRUCTING AND STUDYING NOTES FROM ON-LINE TEXT: Why Filling the Blanks In a "Partial–Notes" Format May Lead to Higher Performance On Delayed Higher-order Tests

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Constructing and Studying Notes From On-Line Text:

Why Filling the Blanks In a "Partial-Notes" Format May Lead to Higher Performance On Delayed Application Tests

For some time now researchers have acknowledged the fact that active involvement in a learning process (e.g., notetaking), can lead to better performance on tests (viz., transfer or application). In similar terms, parallel that with what Pressley and McCormick (1995) and what they have pointed out that learning strategies involve processing over and above processes that are a natural consequence of carrying out the learning task (i.e., reading and decoding words and sentences from text). So then, what is a learning strategy? Weinstein and Mayer (1986) have defined a learning strategy as "a student's activity during learning aimed at improving the outcome of learning" (p. 315). Some researchers suggest that the more students actively engage in a task (e.g., taking notes while reading from a text), the deeper they process the information and are better able to apply it to new situations (Dreher & Guthrie, 1990; Kintsch and Kintsch, 1995). Mayer (1996) has asked the question of what strategies should students use when confronted with expository text for learning and understanding on transfer tests. Further, meaningful learning is reflected in good retention and good transfer, so that students not only have the basic knowledge available in their memories but also can use it productively to solve new problems over a period of time (Mayer & Wittrock, 1996).

Graphical organization of notes

Moore and Readence (1984) have suggested that graphic organizers produce the most learning when they follow the text. The research by Corkill (1992) suggests that spatial study notes work best when the conditions include situations where students will not make appropriate connections between prior knowledge and the new material without help. She concluded that

spatial study notes (e.g., advance organizers) help to facilitate recall of facts when testing after a brief delay (e.g., 24 hours). Her key recommendation was to allow students to have enough time to study the new material and displays in order to facilitate comprehension of the learned information most effectively.

The use of spatial displays to depict text structure and relationships among key terms and concepts has also been studied by Alverman (1981, 1986). She suggests that study notes create an effect that is nested within a perceptual comprehension process rather than a verbal process. That is to say, study notes organize the information in a way that students not only read the information, but see it as well (Hanf, 1971). Study notes have been shown to be beneficial in organizing information in a presentable and understandable manner (Jones, Pierce, & Hunter, 1989). Information arranged hierarchically is generally easier to retain and retrieve than a linear structure (Bransford, 1979). Also, developing a graphic organizer entails deep processing in order to reorganize the information and display interrelationships among key ideas and concepts (Anderson & Armbruster, 1985). To a slight extreme, Robinson and Schraw (1994) have posited that Graphic organizers may even communicate concept relations too effectively when compared to outlines.

An argument for partial notes

Study notes that are provided to students by the instructor can be an effective strategy for learning when the study notes accompany text (Guri-Rozenblit, 1988b; Holliday, Brunner, & Donais, 1977; Koran & Koran, 1980). However, when students construct their own study notes to accompany a corresponding text, they performed better than students who studied from the notes provided by their instructor (Armbruster & Anderson, 1982; Crooks & Katayama, submitted; Russell, Caris, Harris, & Hendrieson, 1983). The activity of recording notes serves an encoding function (DiVesta & Gray, 1972) in that information is internally and externally encoded in a more permanent fashion rather than a temporary fashion (e.g., instructor provided notes). Fisher and Harris (1973) found support for the effect of taking and studying one's own

notes over studying instructor's notes alone. This study made the claim that when students reviewed instructor made notes, there was greater interference on learning when the test was administered immediately. Kiewra (1985) found similar results in that when students took and reviewed their own notes, they answered more than 20% of the questions correctly on the test than did students who studied the instructor's notes. Similarly, Kiewra and Frank (1988) found that personal lecture notes, whether complete or incomplete, were effective study notes because they were well recalled. Likewise, in a study by Thomas (1978), students recalled proportionately more of their own notes than those provided by the instructor, thus demonstrating evidence for the encoding function of notetaking (DiVesta & Gray, 1972).

Specific advantages of partial notes

Peper and Mayer (1978, 1986) found support that notetaking facilitates external connections and concluded that notetaking is a generative activity that encourages students to build external connections between what is presented and what they know. These findings provide support for why studying from student generated notes may be beneficial for students. However, it has been acknowledged that students may not possess the activated prior knowledge necessary to accommodate the new learning (Kiewra, Benton, & Lewis, 1987). An effective aid for activating relevant prior knowledge and building external connections is a conceptual model proposed by Mayer (1989). Recently, additional benefits have been realized with partial graphic organizers and partial outlines, as students who constructed these types of notes outperformed students with a complete set of notes on application tests (Katayama & Robinson, in press). One thing to consider about these past studies is that they all used hard copies of materials for students to work with. With this in mind, the authors of the present study wanted to see if they could realize similar results as Russell et al (1983), and Katayama and Robinson (in press) if the information was presented on the computer and students were required to study and construct their notes on the computer.

Searching for information can be a two-dimensional task (Winn, 1988). The task involves a linear search, left to right, up to down fashion, constantly scanning back and forth throughout a

text. This process can be time consuming and inefficient in searching for one fact or idea in particular. Text search involves finding a specific subset of information relevant to a particular goal (Dreher & Guthrie, 1990). From their studies, they found that efficient searchers differed from less efficient searchers by spending relatively more time choosing categories of text than extracting information from categories. They suggest that the form of a text can be divided up into sections or segments in which selective inspection can be used to search for information easier. Therefore organization and strategy come into play. Guthrie (1988) found that more efficient searchers tend to spend more time than less efficient students at the beginning of the task. By using such a method, the more efficient students were able to allocate a smaller portion of their time conducting the actual search.

Hidi and Anderson (1986) and Kintsch and Kintsch (1995) have conducted research in the area of text extraction and selective organization in text summarization. These studies concur with Dreher and Guthrie's study that the reader must decide which elements within a text are worthy of extracting into the summary and which should be ignored. Again, they concluded that many students seemed to lack the search proficiency to identify main points in text, but little has been found on why they seem to lack this skill.

Immediate and delayed testing conditions

Several studies have shown that declarative and procedural information are both recalled at a much higher rate by students tested immediately than students tested after a reasonable delay (e.g., two days to two weeks). Obviously, the longer the delay between studying (including notetaking and reviewing) and testing, the lower the probability that students will recall the information is expected. Few studies have taken a serious look at the affects of type of notes format has on delayed testing. Very few studies have investigated the effects of student engagement in note construction has on delayed testing.

In a recent study, Robinson, Katayama, Dubois, and Devaney (1998) found that GO's (two-dimensional notes format) were advantageous for students who took their test in a delayed condition. Other studies have found similar results when controlling for cognitive style (Kardash,

1988), text headings (Grant & Davey, 1991; Holley, et al., 1980), and mnemonic aids (Iaccino & Sowa, 1988). The one thing that all these studies had in common is that they utilized a review period before the delayed testing occurred. Given, that this mode of "review" is most realistic of how many college students prepare for an exam, it truly does not test their long-term retention of information, especially after a one-week delay.

The present study

Although there has been a considerable amount of research with study notes, a common weakness has been that many study notes have been provided to students in a completed format. That is to say, students in nearly all of the past studies have not been required to search and write the textual information in their study notes. Traditionally, students would just study the provided set of notes followed with some sort of knowledge or comprehension test. Therefore, a particular consideration of this study includes providing some students with a partial format of notes allowing them to fill in the missing information. Another question that becomes an issue of whether students will perform better on fact, structure or application tests when provided with a completed set of notes, or whether students retain more of the information when they are required to search and fill out their partial set of notes. The present study was designed to investigate the effectiveness of two types of notetaking formats: a completed set of notes, and a partially completed format of notes (approximately half of the information is left blank). The design was also designed to investigate the effect of test taking conditions: immediate (shortly after the study session) and delayed (after one week). We were curious if there may be an interaction between notetaking condition and test taking condition.

Statement of the Problem

Reviewing a complete set of notes usually produces higher achievement than not reviewing notes at all (Collingswood, & Hughes, 1978; Kiewra, 1985; Peper & Mayer, 1986; Russell, et al, 1983). What is not clear is how much active participation in completing a set of notes plays a role in the outcome on higher-order tests such as transfer and application. Could this active process be more beneficial than providing students with a completed set of notes?

Very few studies have tried to compare the "amount of information" provided for students effect on their comprehension and application of a text passage.

Research Question

The question of interest becomes whether the amount of information provided in the study notes (complete vs. partial) as well as testing conditions (immediate vs. delayed) effect students' scores on fact, structure, and application tests? This question has been answered in part by Russell et al (1983) with the use of outlines and lecture notes, but not with graphic organizers. They found completed notes to be most effective in an immediate testing condition, skeletal and partial notes most effective after a two-week delay, and no single type of notes was most effective after a two month delay. Also, as Robinson, Katayama, Dubois, and Devaney (1998) have concluded, while providing students with materials may be a good idea, most would agree that it is even better to have students construct their graphically organized notes themselves by following a provided framework (e.g., row and column headings).

Operational Definitions

Complete Notes. This format of study notes involves fully completed notes consisting of major headings and categories for which the information is provided. Because all the pertinent information is provided in a completed format, students are not required to search and extract any extra information from the text.

Partial Notes. This format of study notes consists of notes that are partially completed with information (approximately 50%). All of the major and headings and categories are provided in this format. Students are required to search and extract the missing information from the text to complete the partial notes.

Winn and Solomon (1993) have suggested that when diagramming material that is unfamiliar to students, designers should be careful where they place concepts (e.g., vertically or horizontally) and subject categories (e.g., along the left-hand side or across the top). In their research they recommend that it is more effective to place attributes to the right of and below the

categories of the superordinate concepts. That way when the display is laid out in a skeletal format, the rest can be filled in and read with ease following a left-to-right, top-to-bottom sequence. This effective format is consistent with western culture and the English pattern of reading verbal material.

Immediate Testing. Operationally defined by Haynie (1994) as a commonly employed evaluation of teacher-made tests by which testing occurs at the time of instruction or immediately thereafter.

Delayed Testing. Operationally defined by the researchers of the present study as a one week delay between study session (constructing or studying notes and reviewing them) and the testing session.

Methodology

This study investigated the effects of two types of notetaking formats (complete vs. partial) and two testing conditions (immediate vs. delayed) on posttest performance (factual, structural, and application tests). The complete notes condition provided students with all of the pertinent information for the concepts presented in the text. The partial condition provided students with approximately half of the notes and required the students to key in the missing notes. Figure 1 presents an example of the partial notes format. Both conditions provided students with basic headings for conceptually organizing their notes. For example, column headings consisted of "definition" and "purpose" and row labels consisted of topics related to the content of the text passage. For the testing conditions, students were randomly assigned either to the immediate testing condition or the delayed testing condition with both groups receiving the same amount of time to study and take the tests.

Participants

Sixty-seven students from three graduate educational psychology courses at a large state university in the mid-west participated in this experiment for course credit. Of the 67 students, 51 were female (76.1%) and 15 were male (22.4%). One student did not indicate gender (1.5%). Thirty-four students were in the complete notes condition and 33 students were in the partial notes condition. Thirty-four students were in the immediate testing condition and 33 students were in the delayed testing condition. From the self-reported demographic/attitudinal surveys, forty-two students had graduate GPA's of 3.75 or higher, twenty-two students had GPA's between 3.25 and 3.74, and two students had GPA's between 2.25 and 3.24. One student did not indicate graduate GPA.

Materials

The study took place in an IBM computer lab that housed thirty-three Micron Millennium Pentium PC's (operating at 200mhz) with 17 in. monitors. All computers were fully functional. All study materials were presented on-line as the program was installed on the local server. The study materials included a blended chapter-length text (approximately 3500 words) covering the basics of educational research (i.e., Gall, Borg & Gall, 1996; Howell, 1992; Kiess, 1996; McMillan, 1996; Shavelson, 1988), five sets of study notes (corresponding to each of the text passages), and three tests: factual, structure, application, and a demographic/attitudinal survey.

Text. An expository text consisted of five independent scrollable screens with each screen covering a particular topic of educational research (i.e., the role of statistics in research, sampling methods, types of variables, scales of measurement, types of validity). Each passage of text consisted of approximately 700 words or the equivalent of two pages in a textbook (without any graphics).

Study notes. Five sets of study notes accompanied the text in two very distinct versions: a complete set of notes and a partially completed set of notes. Both the complete and partial sets of notes were graphically organized in a two-dimensional matrix (rows and columns) that provided headings across the top and down the left hand column. Because the literature has been somewhat split between the use of headings (see Holley, et al, 1980 and Grant & Davey, 1991) we wanted to further the investigation of the effects of notes headings on notes condition (complete vs. partial) as well as testing condition (immediate vs. partial). The complete sets of notes were equally completed for each passage of text, which were also arranged in the same two-dimensional matrix. The average amount of notes per passage for the complete notes was 160 words per screen. However, it needs to be noted here that we observed a few students in the complete notes condition trying to key in "additional" notes on their screens. And the way the program was set up, it was possible for them to do so. The program would not save any additional notes, but the fact that the students could key in extra notes beyond what was provided for them posed a possible threat. In the three cases where this was noted, the experimenters asked the students not to key in extra notes, but to just study the notes on their screens. The partial set of notes were equally completed for each corresponding passage of text and averaged approximately half as many words per screen. It should be noted that the first and second screens were organized in a 2x2 matrix. The first screen provided the headings of "descriptive" and "inferential statistics" by "definition" and "purpose" whereas the second screen provided the headings of "random assignment" and "random selection" by "definition" and "example". The third and fourth screens were organized in 3x2 matrix headings. The third screen provided the headings of three types of variables: "independent," "dependent," and "extraneous" by "definition" and "example". The fourth screen provided the heading of scales of measurement:

"nominal," "ordinal," and "interval-ratio" by "definition" and "example". The fifth screen was organized in a 3x3 matrix providing three types of validity: "content," "predictive," and "concurrent" by "definition," "purpose," and "example".

Factual Test. The factual test was taken on-line and consisted of 15 multiple-choice items. Students could earn a maximum score of 15 on the factual test. The items were based on information explicitly stated in the text. The following is an example of an item on the fact test:

A _____ is employed when all members of a defined population have already been placed on a list, and every tenth name is selected for the sample.

a. linear systematic sampling method
b. stratified random sampling method
c. cluster sampling method
d. random assignment method

Structure Test. Following the recommendation of Eggen, Kauchak, and Kirk (1978) we constructed a structure test to examine the effects of hierarchical cues on the learning of concepts. We were unable to program the structure test on-line. Therefore, this test was distributed as a hard copy. The structure test consisted of 14 fill-in-the-blank items in which students had to recall information pertaining to the hierarchical structure of the text. More specifically the structure of each text passage contained a superordinate concept (i.e., Scales of Measurement), subordinate concepts (i.e., Nominal scale), and coordinate concepts (i.e., Nominal, Ordinal, Interval-Ratio). In order for students to do well on the structure test, they needed to understand the hierarchical structure of the concepts within the text as well as the

coordinate relationships among the subordinate concepts. Students could earn a maximum of 14 on the structure test. The following is an example of an item on the structure test:

1. List three general scales of measurement used in the behavioral sciences.

_____ _____ _____

Application Test. The application test was also distributed as a hard copy and consisted of 10-matching items in which students had to apply their understanding of educational research to novel situations (similar to Zimmer, 1985). As the name suggests, this test required students to use a higher order of thinking (e.g., application) as opposed to a fact recollection (e.g., knowledge) to arrive at the correct answer. Students could earn a maximum score of 10 on the application test. The following contains the directions and sample item taken from the application test:

Match the appropriate term by letter with each of the following scenarios. Note that each term may be used once, more than once or not at all. Mark your answers in the space provided.

a. Content validity	f. Independent variable	k. Ordinal scale
b. Control variable	g. Inferential statistics	l. Predictive validity
c. Dependent variable	h. Interval-Ratio scale	m. Random Assignment
d. Descriptive statistics	i. Linear-systematic sample	n. Stratified Sample
e. Face validity	j. Nominal scale	

_____ Dr. Freudsex has been collecting demographic data from his students for the past two years. His data set includes students' age, sex, year in school, major, and ethnicity. These variables are most likely to be analyzed using which type of scale?

Demographic/Attitudinal Survey. A 10-item attitudinal survey was administered immediately following the tests. The survey was used to gather information about the students in the study. Four items consisted of self-reported demographic information (e.g., gender, major, class, gpa). Six items pertained to the students attitudes (e.g., prior knowledge of the content, how easy the notes were to complete, how they liked taking their notes on the computer, how much effort they put into their notes, did they have enough time to complete the assignments in the two sessions, did they find their notes helpful when they studied for the tests). These items were self-rated on a five-point Likert-scale where 1=Strongly Disagree (SD), 2=Disagree (D), 3=Neither Agree or Disagree (N), 4=Agree (A), and 5=Strongly Agree (SA).

Procedure

This experiment incorporated two sessions: A notetaking/reviewing session and a test taking session. At the beginning of the first session, students were randomly assigned to one of the two notes conditions (complete or partial) as well as test taking conditions (see description below) and were brought into the computer lab where they were asked to have a seat and wait for directions. Once all students were seated at their computers, the experimenters (two university faculty, one graduate assistant, and a technology associate) went over the directions and gave a brief demonstration of how to navigate through the text passages and notes fields (see figures 1 and 2 for examples of text and notes fields). Students were informed that they would have approximately 90-minutes to complete and study their notes in the first session. They were

instructed to go back and review their notes if they finished their tasks before the 90- minute time limit was up. Finally, students were asked to do their own work and to put forth their best effort during the 90-minute session. At the end of the first session, students in group two were asked not to discuss the material with one another outside of class and dismissed until the next week. At the same time, group one was asked to take a five-minute bathroom break and return to begin session two (test taking). Upon returning from the five-minute break, students in group one were asked to click the "exam" button on their options window and to take the factual multiple choice fact test on-line. After approximately 10-minutes, when all the students had completed the factual test, they were instructed to submit their answers, which were immediately sent to the server and were asked to log-off their computers and to take out a pen or pencil to take the hard copy structure and application tests. The structure test took approximately five minutes to complete and the application test took approximately 10 minutes to complete respectively. Once those tests were completed, a 10-item attitudinal survey was administered and completed within five minutes at which time students were dismissed from the study.

Because this study investigated the effects of immediate and delayed testing conditions, half of the students were randomly assigned to the immediate testing condition (Group 1, n = 33) and the other half were assigned to the delayed testing condition (Group 2, n = 33). For both groups, the experiment consisted of two sessions. The first session was a 90-minute study period in which both groups of students were instructed to read, study the notes (Group 1), take notes (Group 2), and review the notes (both groups). The second session was a 30-minute period of testing and completing the attitudinal survey. Students were not able to go back and review their notes before taking the tests. Students in group two returned one week after the first session in the same computer lab and were asked to sit at the same computer terminal as the first session.

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Students were asked to logon using their ID numbers and their condition would automatically come up to the instructions page at which time the students were asked to click the "exam" button on their options window and to take the factual multiple-choice test on-line. After approximately 10-minutes, all the students had completed the factual test and were instructed to submit their answers to the server and were asked to log-off their computers and to take out a pen or pencil to take the hard copy structure and application tests. Again, the structure test took approximately five minutes to complete and the application test took approximately 10- minutes to complete. Once all tests were completed, a 10-item attitudinal survey was administered and completed within five minutes at which time students were dismissed from the study.

Results and Discussion

Separate univariate analyses of covariance (ANCOVA) were conducted on the factual, structure, and application test scores controlling for "prior knowledge" reported on the survey. Analyses were conducted using SPSS (version 9.0). All tests were conducted at alpha = .05 level of significance. According to Levene's F-test, the assumption of homogeneity of variances were supported for the factual test, $F(3, 63) = 2.27$, $p = .090$, for the structure test, $F(3, 63) = 6.46$, $p = .588$, and for the application test, $F(3, 63) = 2.21$, $p = .096$.

Prior knowledge of the content

Even though most students in this particular graduate program take the educational psychology course before they take a research and or any statistics course, we could not guarantee that each student had limited prior knowledge of the content of our study. It could be possible that a few students may have a rather strong background in "Educational Research" from their undergraduate studies or related work experience. Because of this possibility, the researchers had a concern that students' prior knowledge may impact the end results of the study.

Therefore, to help control for students' prior knowledge, we had each student rate their prior knowledge (on a scale of 1-5, where 1 = no prior knowledge, 5 = very knowledgeable) of the topic of "Educational Research" which was answered in question number one on the attitudinal survey. A Pearson's correlational analysis was conducted on the "prior knowledge" question and the dependent measures (factual, structure, and transfer) to see if prior knowledge was significantly correlated to the tests). The Pearson's correlational coefficient indicated that prior knowledge was significantly related to the factual test, $r = .256$, $p = .036$, and the transfer test, $r = .257$, $p = .036$. However, prior knowledge was not significantly related to the structure test, $r = .142$, $p = .253$. As a result, the researchers decided to treat the "prior knowledge question as a covariate in the analysis. However, after running an analysis of covariance (ANCOVA), the covariate of prior knowledge did not turn out to be statistically significant, $F(1, 62) = 1.98$, $p = .165$ on the factual test, the structure test, $F(1, 62) = 0.95$, $p = .759$, or on the application test, $F(1, 62) = 1.48$, $p = .229$. Based on the non-statistically significant covariate, it was concluded that students' prior knowledge was not related to the outcomes of the three tests.

Notetaking conditions

Table one presents the means and standard deviations for each of the groups on the three tests. The main effect of notetaking format (complete vs. partial) was not statistically significant on the factual test, $F(1, 62) = 2.55$, $p = .116$. This result indicates that the amount of information (complete or partial) did not affect students' scores on factual items. Likewise for the structure test, the main effect of notetaking format was not statistically significant, $F(1, 62) = .816$, $p = .370$. However, on the application test, the main effect of notetaking format was statistically significant, $F(1, 62) = 25.13$, MSE = 1.27, $p = .000$. Students in the partial condition ($M = 5.52$,

SD = 1.22) performed significantly better than those in the complete notes condition (M = 3.09, SD = 1.47) on the combined scores from the immediate and delayed testing conditions.

Testing conditions

The main effect of testing condition (immediate vs. delayed) was statistically significant on the factual test, F(1, 62) = 27.72, MSE = 1.60, p = .000. This result indicates that the testing condition did affect students' scores on factual test. Students in group one ($M_{immediate}$ = 10.56, $SD_{immediate}$ = 1.33) scored significantly higher on the factual test than those in group two ($M_{delayed}$ = 8.85, $SD_{delayed}$ = 1.32). Likewise for the structure test, the main effect of testing condition was statistically significant, F(1, 62) = 21.25, MSE = 1.76, p = .000. This result indicates that the testing condition did affect students' scores on the structure test in favor of group one ($M_{immediate}$ = 10.41, $SD_{immediate}$ = 1.50) as they scored significantly higher than group two ($M_{delayed}$ = 8.88, $SD_{delayed}$ = 1.17) on the structure test. Likewise, for the application test, the main effect of test taking condition was statistically significant, F(1, 62) = 16.38, MSE = 1.27, p = .000. As with the previous tests, the students in group one ($M_{immediate}$ = 4.38, $SD_{immediate}$ = 1.13) scored significantly higher than group two ($M_{delayed}$ = 3.19, $SD_{delayed}$ = 1.20) on the application test across both notetaking formats (complete and partial).

Notetaking format by testing condition interactions

The notetaking format (N) by testing condition (T) interaction was not statistically significant, F(1, 62) = 2.85, p = .096 on the factual test. This finding suggests that there was no combination of notetaking format and testing condition that contributed to higher performance on the factual test.

The N x T interaction for the structure test was not statistically significant, F(1, 62) = 3.81, p = .055. But there is a practical significance of this finding extending that students in the

partial notes format and tested in the delayed condition performed slightly higher than those in the complete notes format and the delayed testing condition. Because this finding was only marginal, and because the covariate of "prior knowledge" was not significant across the conditions, we decided to run a separate analysis without the covariate. By taking out the non-significant covariate and running a univariate factorial ANOVA, we observed a significant N x T interaction, $F(1, 63) = 4.19$, $p = .045$. In addition, SPSS reports a partial eta-square, which was observed at .062 for the structure test. According to Stevens' guidelines for effect size, this equates to a medium effect (Stevens, 1999, p. 192).

The N x T interaction for the application test was statistically significant, $F(1, 62) = 9.01$, $p = .004$. Even though students in the complete notes condition scored about the same as students in the partial notes condition when tested immediately ($M_{complete} = 4.12$, $M_{partial} = 4.64$), the difference was in the delayed testing condition where students in the complete notes condition scored significantly lower that those in the partial notes condition ($M_{complete} = 2.06$, $M_{partial} = 4.30$). It is clear that the students in the delayed condition benefited more from the partial notes than with the complete notes because there was less of a drop off of scores in the delayed testing condition.

Conclusion

The purpose of this study was to investigate the relative effectiveness of two notetaking formats (complete vs. partial) and two testing conditions (immediate vs. delayed) across three dependent measures (factual, structure, and application tests). Results indicated that partial notes were more effective than the more conventional completed set of notes for helping college graduates apply text knowledge when the notes were taken on the computer. Therefore, there appears to be a relationship between an actively taking notes and the application of text

information after a one-week delay. In particular, partial notes seem to lend themselves best to the application of the concepts to novel situations and moderately well for text structure. However, the results also indicate that there doesn't appear to be an effect for notetaking format on learning factual information.

In terms of testing conditions, it is quite evident and somewhat ubiquitous that immediate testing has advantages over delayed testing. By reason, recollection of facts, structure, and application are all better retrieved in an immediate testing condition because the information is still "fresh" on the mind. Or, in other words, not enough time has passed for decay or interference to settle in. Basically, rote memorization is best served in immediate testing conditions. On the contrary, delayed testing is not typically well served by rote memorization as the recall of information has more opportunity to be subjected to decay or interference. As a result, performance on delayed tests would be expected to be lower. The present study supported these claims. On all three tests, students in the immediate testing condition outperformed those in the delayed condition. However, the phenomena that we observed had distinctions among the notetaking conditions. The significant interaction on the both the structure and application tests provide evidence that when students study and construct partial notes, they seem to recall the information better on the delayed test than those who are in the complete notes condition.

Limitations

The following limitations were noted in the present study. Findings of the study were limited to college graduates attending a large public university in the Midwest. The content of materials used in the study are applicable to basic statistics and research in the behavioral sciences and may not be applicable to other content areas. Also, the one-week delay testing condition did not allow a review of the notes either (a) provided or (b) constructed from the previous week. In most practical situations, students will take the time to review their notes prior

to the engagement of test taking. Finally, by using random assignment we tried to control for differences between groups but could not be certain that the students were spending equal amounts of time studying their notes as some students finished their task earlier than others.

Recommendations for Future Research

Several things struck us throughout this study as possible modifications, additions, and deletions that may be addressed in future studies. Concerning the design, we would like to see more control of the complete notes condition by not allowing students in this condition to key any additional notes to their screens. By being able to do so, it may very well be taking advantage of the encoding function that DiVesta and Gray have found, and thus, convoluting the results. Even though explicit instructions were given to each of the note conditions, students in the complete notes condition were aware that their counterparts were keying in notes, and this may have encouraged them to do the same. This problem could be eliminated by separating the two conditions in two separate labs (so the partial group who were keying in notes would not distract the complete group trying to study the notes).

Another recommendation for future studies is to somehow put the structure and application tests on-line or to give all three tests as hard copies. Just as long as they are consistent. Giving the fact test on-line and the other tests as hard copies was not consistent. Of course, a new variable has been born: The medium of the test itself. Therefore we may pose a new question: "What are the differences of taking tests on-line vs. on paper?" Also, more items may be considered for the structure and application tests. Perhaps, getting rid of the factual test altogether may free up more time for longer, more in-depth structure and transfer tests.

Future studies may consider varying the length of the delay. The present study only used a one-week delay. Why not look at the effects on a two-day delay vs. a four-day delay? Future studies may want to vary the "partiality" of notes. That is, will there be differences among a notes condition that provides one-fourth of the notes vs. one-half or three-fourths of the notes? Finally, as with most studies, future research would benefit from using different content, where perhaps, prior knowledge is limited or at least easier to control. Using different content may also increase the generalizability of similar studies.

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